

M/1035/002

Southwestern Jordan Valley Ground Water Plumes Proposed Plan

*Addressing Operable Unit 2 of the Kennecott South Zone
and State Trustee's Plan for use of Damage Settlement Trust Funds*

EPA/UDEQ

August, 2000

EPA AND UDEQ ANNOUNCE PREFERRED CLEANUP ALTERNATIVE

The public is invited to comment on a proposal to clean up ground water in Southwest Salt Lake County. The plan was drafted by the U.S. Environmental Protection Agency (EPA), in coordination with the Utah Department of Environmental Quality (UDEQ). The agencies also worked closely with Kennecott, the Jordan Valley Water Conservancy District, and local and state water interests to develop this plan.

The ground water was contaminated by historic mining activities in the Oquirrh Mountains. Several plumes were formed as a result. A pump and treat method has been selected as the preferred cleanup alternative. The agencies have determined that it is necessary to remove the contaminated water from the aquifer to prevent it from spreading. The water will be treated then made available as a public drinking water source.

The public is invited to review and comment on the preferred alternative, as well as the other alternatives considered. The original documents used in the study and selection process - including the Remedial Investigation/ Feasibility Study¹, the Consent Decree between the State Trustee for Natural Resources and Kennecott Utah Copper Corporation, and plans submitted to the Trustee - are available on request at the information repositories. (See page two).

PUBLIC COMMENT PERIOD

August 1 to August 30, 2000

OPEN HOUSE

Tuesday, August 1 from 4 to 8 p.m.

(Brief presentation on each hour)

UDEQ, 168 N. 1950 W. Rm. 101

Salt Lake City

PUBLIC HEARING

Wednesday, August 9 - 7 p.m.

West Jordan City Council Chambers

8000 S. Redwood Road

QUESTIONS?

Project Managers

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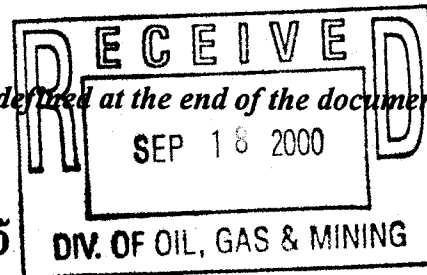
(801) 536-4478

PUBLIC INVOLVEMENT PROCESS

The process is administered under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986². This proposed plan is prepared to fulfill CERCLA public participation requirements. In addition, the State was awarded a Natural Resource Damage Claim settlement to "restore, replace, or acquire the equivalent" of the water lost to contamination. The Trustee (the UDEQ Executive Director) is seeking comment on the proposed cleanup action submitted by Kennecott and the Jordan Valley Water Conservancy District.

EPA and the UDEQ Trustee will select a final remedy only after considering comments from citizens, communities and other governmental agencies. Following public comment, EPA will publish a Record of Decision (ROD)³ and UDEQ will respond to all comments received and document the rationale for the final decision.

Note: Footnoted words are defined at the end of the document.



PUBLIC INVOLVEMENT OPPORTUNITIES

* PUBLIC COMMENT PERIOD

Written comments on this plan and related documents will be taken through August 30. Bring them to the public meeting or send comments to:

Eva Hoffman, 8EPR-SR
EPA Region VIII
999 18th Street, Suite 500
Denver, CO 80202-2466
E-mail comments to: hoffman.eva@epa.gov

Oral comments will be taken at the August 9 Public Hearing (see front). If you need special assistance to participate, contact Renette Anderson at (801) 536-4478 or TDD# (801) 536-4414 at least three working days before the meeting.

RECORD OF DECISION:

Scheduled for Fall, 2000

* INFORMATION REPOSITORIES

The documents referenced in this proposed plan, along with other related documents, are available for public review or copying at the following locations:

West Jordan City Hall
City Recorder's Office
8000 South Redwood Road
Hours: M-F 8 a.m. to 5 p.m.

UDEQ Superfund Branch
168 North 1950 West, 1st Floor
Salt Lake City UT 84116
Hours: M-F 8 a.m. to 5 p.m.

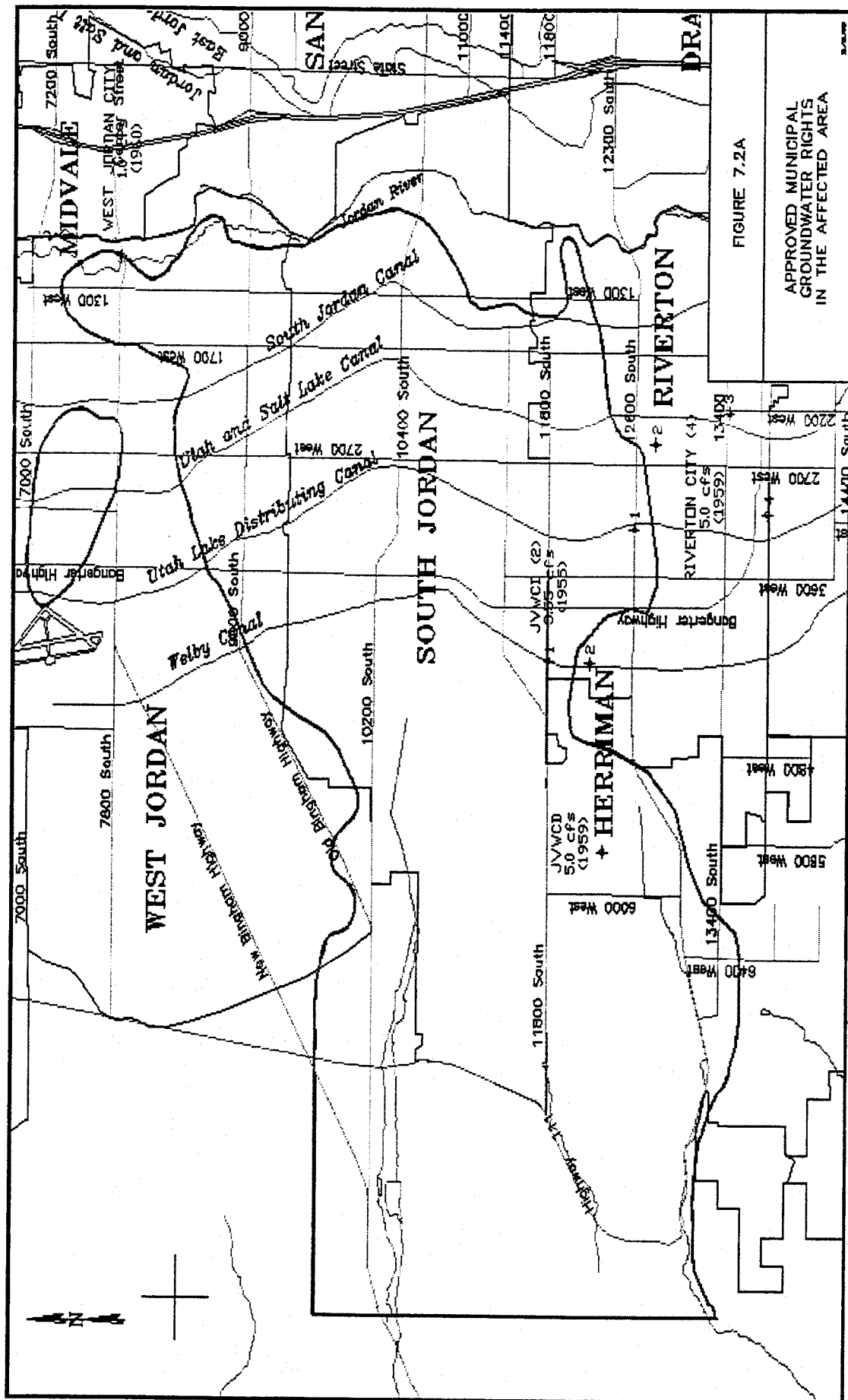
EPA Superfund Records Center
999 18th Street, Suite 500
Denver, CO 80202-2466
Hours: M-F 8:30 a.m. to 4:30 p.m.

Note: Upon timely request, the comment period may be extended. Such a request should be submitted in writing to EPA, postmarked no later than August 25, 2000. Failure to raise an issue or provide information during the public comment period may prevent you from raising that issue or submitting such information in an appeal of the agencies' final decision.

SITE BACKGROUND

Mining has taken place in the Oquirrh Mountains since the 1870s. Historical mining processes, including past and current Kennecott operations, have resulted in contamination of soil and ground water. Rain, snow, and water from mining activity, filtered through waste rock dumps and leached out acids, sulfates and metals. Reservoirs built to hold these waters leaked for many years. Contaminated water also washed down streams and creeks or seeped into the aquifer which, in turn, became contaminated. Non mining sources, such as irrigation canals, may have contributed to the problem.

Groundwater in the area flows underground from the Oquirrh Mountains toward the Jordan River. The existing contamination has spread out as plumes within the aquifer underlying the communities of West Jordan, South Jordan, Riverton, Herriman and adjacent unincorporated areas of southwest Salt Lake County. A recent study indicates that the volume of water with concentrations of chemicals above health standards is about 171,000 acre-feet of ground water.



The map shows the location of the ground water plumes in relation to the impacted communities. For study purposes, the plumes were divided into two zones. Zone A is adjacent to the Large and Small Bingham Reservoirs, cemetery pond, waste rock dumps, and the historic Lark operations. The Zone A plume contains a core which is made up of acidic water, heavy metals, and high concentrations of sulfates as well as an area of lower sulfate concentrations. Zone B includes the lower sulfate concentrations which leaked out of the South Jordan Evaporation Ponds.

There are three major sources of contamination:

1. Early miners noticed that water percolating through their dumps came out the bottom and contained substantial concentrations of acid, sulfate, and metals. Utah Copper (a predecessor of Kennecott) began capturing the water coming from its dumps as early as the 1920s in order to recover the metals. In 1942, Kennecott began placing recycled water on the waste rock dumps to actively leach metals from the waste rock. This water was collected and sent through an extraction process to remove copper. Some of the recycled water was lost from the circuit because of leaks.

Between 1965 and 1991, Kennecott stored some of this water in three collection reservoirs located east of Copperton. Investigation showed that these reservoirs were a major source of contamination that impacted the aquifer. The reservoirs were not lined and they leaked about 1 to 2.8 million gallons a day. The soils neutralized some of the acid. The contaminated ground water has moved about five miles from the original source. Kennecott reconstructed the leaking reservoirs in 1991 and lined them with clay and two layers of High Density Polyethylene (HDPE) plastic.

2. Another source was mining operations in the area near the former town of Lark. Two tunnels, the Mascotte Tunnel (1902 - present) and the Bingham Tunnel (1952 - present), discharged contaminated mine waters into Midas Creek, where some of it soaked into the ground. Sometimes the mine waters were used for irrigation by local farmers. The tunnels still discharge contaminated mine waters, but these waters have now been directed toward Kennecott's industrial process water circuit. Exposed waste and mill tailings may also have contributed to the problem.

3. The third major source was the former South Jordan Evaporation Ponds, located west of 4000 West between 10200 and 11800 South. This area was used to dispose of extra water from Bingham Creek that was not needed in mining. The water was diverted to ponds where it either evaporated or soaked into the ground. In the 1930s, this water was not treated. In the 1980s, the water was treated with lime before entering the ponds. In 1994, Kennecott removed all the sludges to a central repository located within the footprint of the original ponds.. The contaminated water which leaked into the ground has now spread nearly to the Jordan River.

SUMMARY OF SITE RISKS

Action is being proposed because EPA and UDEQ have determined there is a risk to public health and the environment from the ground water plume. EPA considers the principal threat in the area to be the original sources of the ground water contamination which are now controlled. The secondary threat is the ground water plume.

The contaminants of concern depend on location:

In Zone A, near the former Bingham Reservoirs, the contaminants are acidic water, heavy metals, and sulfate. Their concentrations exceed drinking water standards, sometimes by a factor of one hundred or more.

In Zone B, the contamination is solely due to sulfates.

Acidic waters can corrode pipes. Some heavy metals are carcinogens and others do damage to livers,

kidneys and the nervous system. EPA has determined that drinking water with sulfate concentrations in excess of 1,500 mg/l present a health threat, especially to visitors and infants. Local residents will build up a tolerance to sulfates. Visitors to the area who may drink the water may experience diarrhea. Infants are particularly at risk because the diarrhea can cause dehydration.

Sulfates in both zones exceed State Drinking Water Secondary Standards. Public water suppliers keep the sulfates lower than 250 mg/l because of taste and odor problems unrelated to health and because of marketability issues.

Experiments at the site indicate that water with less than 2000 mg/l sulfate can be used for irrigation without harming grass, shrubbery, trees, or alfalfa. Two experiments were performed, one by Kennecott and the other by Utah State University, in which different grasses, landscaping shrubs, and garden vegetables were investigated to see the effects of irrigating with water having different sulfate concentrations.

A major concern to the agencies is the proximity of the contaminated ground water plumes to the municipal well fields of West Jordan and Riverton. If nothing is done to control the spread of the plume, pumping by these two municipalities could draw the contaminated waters in the direction of the municipal wells and might cause the cities to have to abandon them. Kennecott has filed a petition with the State Engineer to place a moratorium on increased pumping rates and new well installations. In return, Kennecott is willing to provide alternative water sources to assist impacted well owners

REMEDIAL ACTION OBJECTIVES

The proposed action outlined in this plan is the result of environmental investigations and actions taken in the Kennecott South Zone. The surface waste problems were addressed in separate CERCLA actions. The surface wastes that were cleaned up were Bingham Creek sediments, the Lark waste rock and tailings, Butterfield mine waste rock, South Jordan Evaporation Ponds sludges, and the Large and Small Bingham Reservoir reconstruction. State ground water authorities are being used to control any potential leakages from the waste rock dumps, leachate collection system, and operating reservoirs.

This plan addresses both CERCLA and Natural Resources Damage Claim concerns over the ground water contamination. While the administration of the Zones A and B may appear to be separate, both agencies understand that the cleanup of the two are linked. EPA's focus has been on the Zone A plume because the State of Utah's settlement and involvement has been able to adequately address the issues involved with the Zone B plume. The State Trustee is concerned with cleanup of Zone A and B plumes. In order to obtain a full rebate under the settlement, Kennecott is required to make available 7,000 acre feet of water a year. This, in turn requires the company to treat water in both zones to generate that volume.

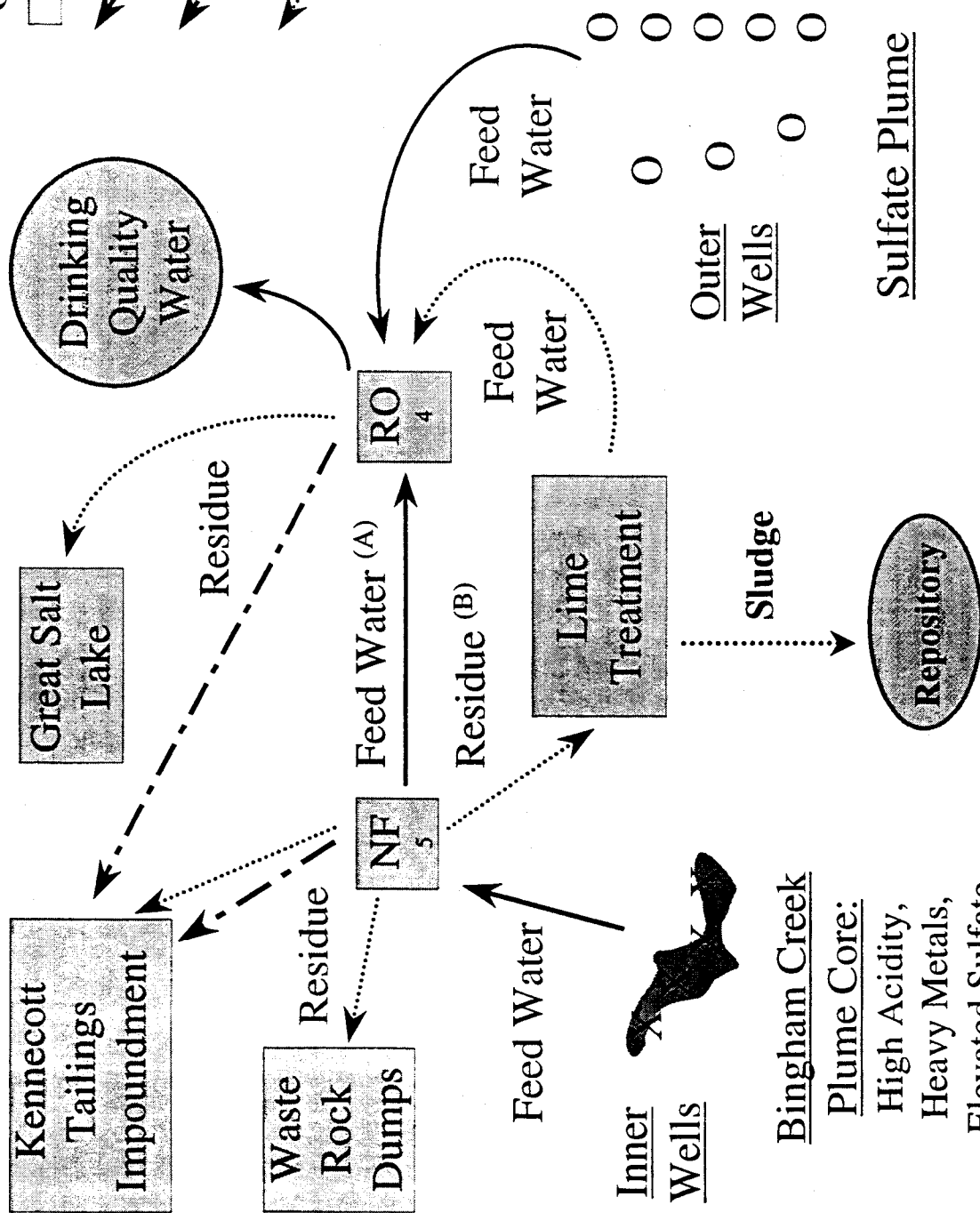
The major CERCLA objectives are:

- (1) Prevent public exposure to contaminated ground water which exceeds drinking water standards;
- (2) Prevent exposure of aquatic organisms to contaminated ground water which may enter the Jordan River or the Great Salt Lake;
- (3) Prevent further movement of the contaminated ground water into previously uncontaminated areas and to nearby municipal wells;

Zone A Plume-Treatment Flow Chart (E)

- X - Acid Well
- O - Sulfate Well
- - Treatment Option
- Flow Direction "Life of Project"
- Flow Direction "Pre-Closure"
- Flow Direction (C) "Post-Closure"

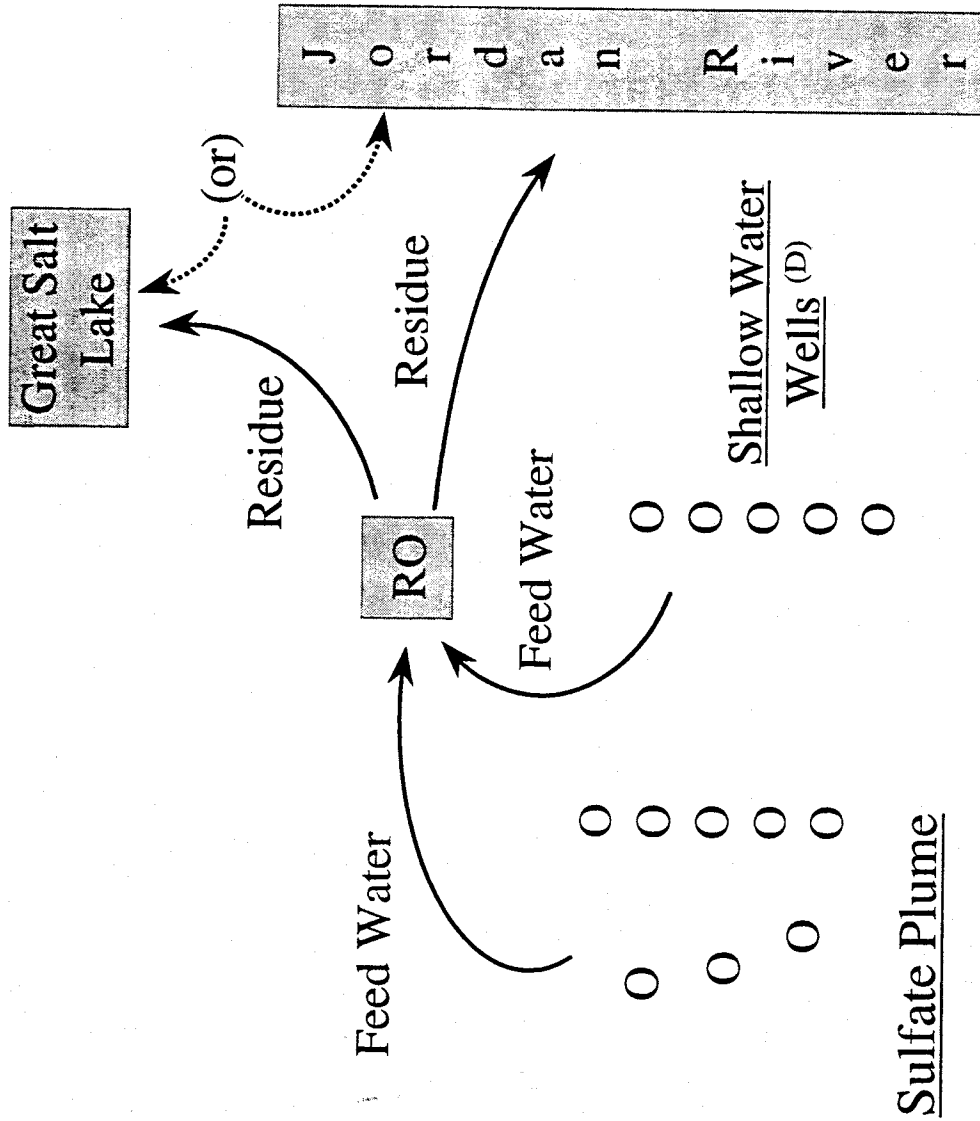
(Locations and Scale are NOT Representative)



Bingham Creek
Plume Core:
 High Acidity,
 Heavy Metals,
 Elevated Sulfate

Sulfate Plume

Zone B Plume-Treatment Flow Chart (E)



Footnotes:

- (A) Feed water is pumped from the plumes and sent to the treatment plants for treatment.
- (B) A residue is the waste material left over from the treatment process.
- (C) There are three "Post-Closure" disposal options for the residue left over from treatment by nanofiltration.
 - i) Disposal into an evaporation pond on the waste rock dumps
 - ii) Disposal into an evaporation pond on the Magna Tailings Pond; or
 - iii) Lime treatment of the residue followed by disposal of the potentially hazardous sludge in a lined repository.
- ⁴ Reverse Osmosis, refer to glossary for definition.
- ⁵ Nanofiltration, refer to glossary for definition.
- (D) Shallow water wells will be pumped to replace the lost portion of water due to the treatment process.
- (E) Please refer to the revised clean up proposal submitted by Kennecott and the Jordan Valley Water Conservancy District to the State Trustee and EPA Remedial Project Manager on April 28, 2000. These are available at the information repository, IES.



- (4) Provide treated drinking water to the municipalities impacted by the contamination.

The major objective of the Natural Resource Damage Claim is to "restore, replace, or acquire the equivalent" of the lost resource (in this case ground water). As part of the settlement between the State of Utah and Kennecott, the company was required to perform the following:

- a. Complete the Remedial Investigation/Feasibility Study as part of the CERCLA action;
- b. Extract from the acid/metal plume a rolling average of 400 acre feet on an annual basis to begin removing some of the contamination and contain the plume;
- c. Complete additional source control measures. This entailed the completion of the eastside collection system and the Bingham Creek cutoff systems, in compliance with Kennecott's ground water discharge permit.
- d. Create a trust fund, to include a cash sum of \$9 million and an irrevocable letter of credit in the sum of \$28 million, to be invested and eventually used to "restore, replace, or acquire the equivalent" of the lost resource to the benefit of the public within the affected area. Under the agreement, Kennecott can apply for a rebate of the trust fund sum based upon the quantity and quality of municipal (drinking) water they provide through treatment of the plume waters.

SUMMARY OF REMEDIAL ALTERNATIVES

Some cleanup strategies were eliminated in an initial screening because they were impractical or ineffective for the chemicals at the site. The Remedial Investigation/Feasibility Study (RI/FS) proposed six alternatives for further evaluation.

Alternative 1 is called the "No Action" alternative, although this is not strictly the case. It includes maintenance of pipelines, canals, and ponds used by Kennecott to provide source control. These controls are supervised under the UDEQ Ground Water Protection Program. Clean up of the ground water would rely solely on natural flushing of the aquifer. Because the aquifer is so severely contaminated, this could take 800 years or longer. The plumes may affect the Jordan River or the municipal well fields east of the river if they are not controlled.

Alternative 2, "Institutional Controls" proposes that Kennecott maintain the source control described in Alternative 1 and seek methods to prevent further well drilling in the area so that people would not be exposed to contaminated ground water. Institutional controls might include a State Engineer's moratorium on drilling, purchase of lands overlying the plumes, or purchase of impacted water rights. Like Alternative 1, there is no active restoration of the aquifer so clean up could take 800 years or longer. The plumes may affect the Jordan River or the municipal well fields east of the river if they are not controlled.

Alternative 3, "Point of Use Management" proposes that Kennecott maintain the source and institutional controls described in Alternatives 1 and 2. Kennecott and the State Engineer are investigating to see if a moratorium on new well installations in the affected area is feasible. Any citizens with private wells would be hooked up to municipal water or, if hookups were not possible, be provided with in-home treatment devices (point of use) such as reverse osmosis units. These units would fit underneath the kitchen sink and would need regular maintenance. Cost would be covered by Kennecott. Cleanup of the aquifer would rely

solely on natural flushing, and could take 800 years or longer. The plumes may affect the Jordan River or the municipal well fields east of the river if they are not controlled.

Alternative 4, "Containment," includes the measures described in Alternatives 1, 2, and 3, plus the installation of a series of barrier wells at the leading edge of the Zone A plume. As the contaminated ground water reaches these wells, it would be pumped and treated. At first, the plume could be treated by reverse osmosis. Eventually, (in five years or so), the part of the plume with the worst contamination would reach these wells and reverse osmosis⁴ would no longer work. Additional treatment, probably using a new technique called nanofiltration⁵, would be needed.

The primary concern with this alternative is that the barrier wells may not completely contain the plume. The secondary concern is that without treatment, the acidic ground water will take hundreds of years to clean itself up. This is because the metals trapped by the soils in the aquifer would gradually be released back into the water when fresh water begins to flush the aquifer.

Alternative 5, "Active Restoration," is the preferred alternative of EPA and UDEQ. It includes the measures described in Alternatives 1, 2, and 3, a barrier well system (outer) at the leading edge of the plume, and additional wells (inner) in the core of the plume.

The inner wells would be pumped as much as feasible in order to remove as much of the core in the shortest time possible. This pumping would drop the water levels in the area of the plume. Although this may affect nearby public and private wells, it may also serve to prevent further migration of the most seriously contaminated part of the plume. Instead of being the primary line of defense as envisioned in Alternative 4, the barrier wells would be a safety net in case any portion of the plume managed to escape withdrawal by the inner wells. Continued monitoring may provide additional information about the plume and the cleanup time frame involved.

Treatment of the outer well water would use reverse osmosis. Treatment of the inner well water would require nanofiltration before further treatment by reverse osmosis to provide drinking quality water. Kennecott proposes to build the nanofiltration and reverse osmosis treatment facility near the Copperton Cemetery along the Old Bingham Highway. While the reverse osmosis residue could be discharged to the Great Salt Lake, the nanofiltration residue will be more heavily contaminated and will need to be handled differently. Options for this residue include (1) disposal into an evaporation pond on the waste rock dumps; (2) disposal into an evaporation pond on the Magna Tailings Pond; and (3) lime treatment of the residue followed by disposal of the potentially hazardous sludge in a lined repository.

The time required to restore the aquifer using this approach is uncertain. Kennecott's ground water mathematical model suggests that the acid plume can be withdrawn in 25 to 30 years. There are two problems in estimating the cleanup time. First, it is difficult to make decisions on information that is limited by the assumptions made by the modeler. Accuracy depends solely upon the assumptions built into the model. Second, some contaminants trapped in the soils of the aquifer will begin to redissolve back into the ground water when cleaner water begins to enter the aquifer. This could continue to pollute the ground water even if the acid plume has been withdrawn. Continued monitoring throughout the cleanup will be required so any unexpected results can be identified and addressed, if necessary. The agencies suggest that treatment in perpetuity may be needed for the ground water to be useable without restrictions.

Alternative 6 is essentially the same as Alternative 5, but the treatment methodology would be lime

treatment for the residues from the nanofiltration process. Acids would be neutralized using lime, creating a potentially hazardous sludge which would have to be disposed of in a lined repository.

The Natural Resources Damage Abatement Alternative was proposed to the State Trustee to treat and contain the plumes, while providing drinking water to the affected communities. Pumping of the sulfate waters in Zone A will coincide with pretreatment and containment of the core waters in the same zone, as described in Alternative 5. The drinking water produced as a result will be combined with the drinking water produced from the treatment of Zone B ground water. This combined drinking water will be distributed to the affected communities so Kennecott can apply for a rebate of the damage claim fund.

The Zone B treatment proposal suggests the installation of wells along 1300 West and another set of wells between 2700 West and the Bangerter Highway. The ground water would be treated using reverse osmosis technology at a plant at the Jordan Valley Water Conservancy District Headquarters. Additional wells would be drilled in the shallow aquifer near the Jordan River. The water district and the Utah Division of Water Quality are investigating the feasibility of discharging the reverse osmosis concentrate into the Jordan River. Sulfate and other components of the concentrate may prevent use of this discharge location.

EVALUATION OF ALTERNATIVES

CERCLA requires that remedial alternatives be evaluated using the nine criteria of the Superfund National Contingency Plan (NCP). These criteria fall into three categories:

The threshold criteria include: (1) protection of human health and the environment and (2) compliance with laws and regulations.

The balancing criteria include: (3) long term effectiveness and permanence, (4) reduction of toxicity, mobility, or volume through treatment, (5) short term effectiveness, (6) implementability, and (7) cost.

The modifying criteria include: (8) state acceptance and (9) community acceptance. In addition, the NCP lists certain specific expectations for ground water remedies. These include the return of useable ground water to beneficial uses (wherever practicable) or prevention of further migration, prevention of exposures, and other risk reduction measures.

The purpose of the Natural Resource Damage Claim settlement is to restore, replace, or acquire the equivalent of the natural resource (ground water) for the benefit of the public in the affected area. The settlement Consent Decree gives specific conditions whereby any plan submitted by Kennecott can receive financial credit from the settlement account. The amount of credit is related to both the quality and quantity of treated water that Kennecott provides the cities. The State Trustee can choose to reject the plan entirely and use the account to fund a different plan.

PREFERRED ALTERNATIVE

EPA and UDEQ prefer Alternative 5, coupled with the Natural Resource Damage Claim Settlement Alternative presented to the Trustee by Kennecott and the Jordan Valley Water Conservancy District. Of the alternatives evaluated, this preferred approach best satisfies the NCP criteria in protecting human health and the environment, and effectiveness in cleaning up the contaminated aquifer. The preferred alternative also

features return of the damaged waters to beneficial use by the public

The agencies prefer the disposal of concentrates from the acid plume into the tailings slurry pipeline while mining operations continue. A diagram of this alternative is given in Figure 2. Mine closure may occur either suddenly due to market turndown or not for 30 years or longer when ore reserves dwindle. The agencies believe that storage and evaporation in a lined facility or lime treatment of the concentrates can be implemented quickly should the mine close without much warning. This would depend on the chemical nature of the residues at the time. At this time, it is not known what effect other waste streams might have on the residues. The agencies also recognize that mine closure might not occur any time soon and, by that time, new technologies might be available for handling the wastes and more might be known about the impact the wastes might have. EPA suggests that investigations be undertaken during operations to determine how feasible it would be to combine cleanup residues with other waste streams.

It is also uncertain at this time whether or not the treatment concentrates would exhibit hazardous waste characteristics. Depending on the alternative finally implemented, a waiver of certain state or federal regulations concerning the disposal of hazardous waste may be requested, based on the remedy meeting equivalent standards. The State is reviewing the Bevill exemption ruling, which contains specific rules applicable to mining waste, to determine if these waivers would apply.

GLOSSARY

1. REMEDIAL INVESTIGATION/FEASIBILITY STUDY: Collection and analysis of information about a site to determine the nature and extent of contamination that may be present, and identification and evaluation of the most appropriate technical approaches to address contamination at the site.

2. CERCLA (Comprehensive Environmental Response, Compensation and Liability Act): A federal law passed in 1980 and amended in 1986 by SARA (Superfund Amendments and Reauthorization Act). The Acts created a special tax that goes into a Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. It also contains provisions whereby industries can clean up their own problems with federal and state oversight.

3. ROD (Record of Decision): A public document that explains which cleanup alternative will be used at the site. The ROD also contains a Responsiveness Summary in which EPA responds to issues raised during the public comment period.

4. REVERSE OSMOSIS: A process for the removal of dissolved ions from water. Pressure is used to force the water through a semi-permeable membrane which will transmit water but reject most other suspended and dissolved materials. The process is called reverse osmosis because mechanical pressure is used to force water to flow in the direction that is reverse of natural osmosis, namely from the dilute to the concentrated solution.

5. NANOFILTRATION: A process which uses a semi-permeable membrane for the selective removal of chemicals from water. The membrane has small pores, allowing the removal of metals and sulfates from the contaminant plume.